INSTRUCTION BOOK

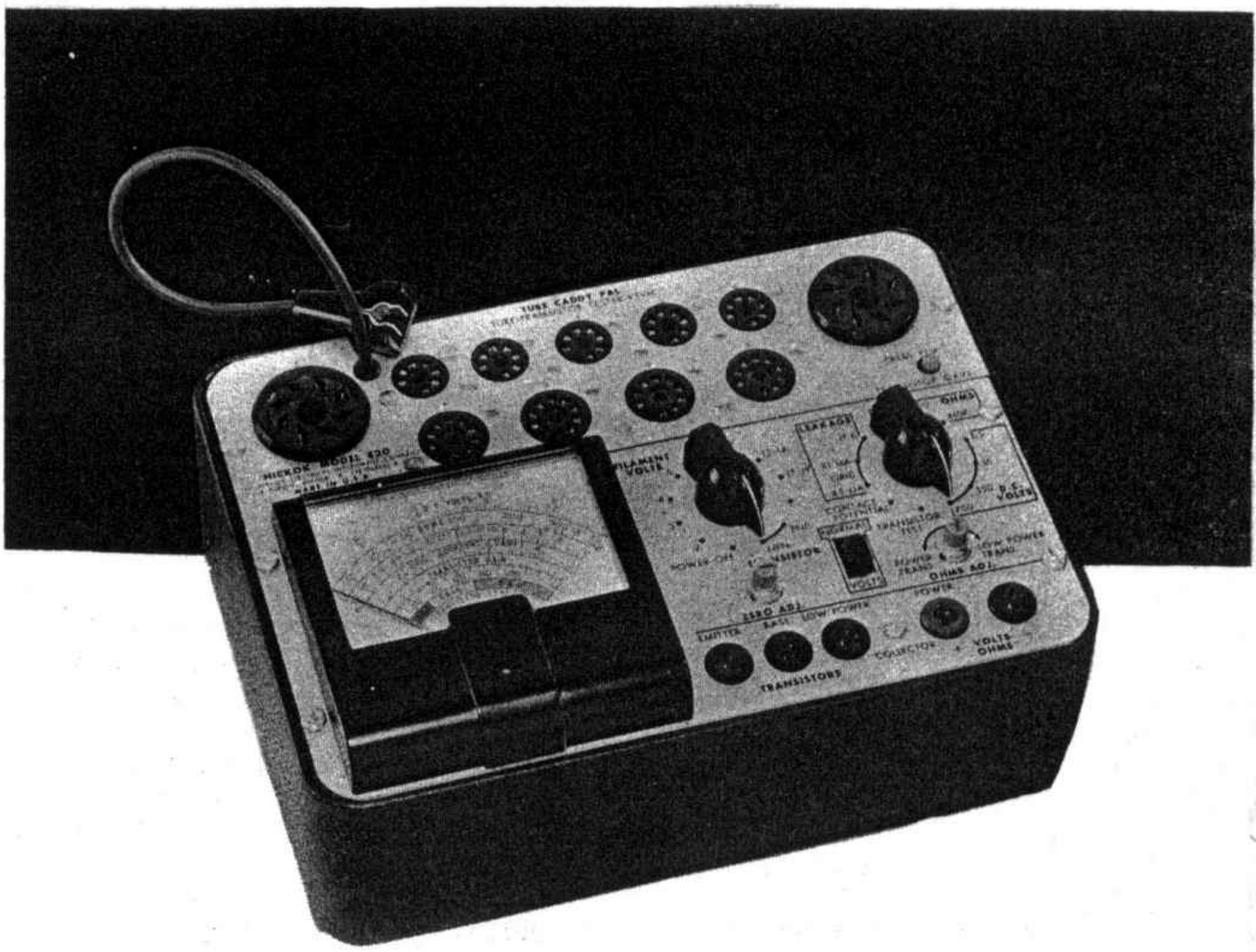
FOR

TUBE CADDY PAL

MODEL 820

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THE HICKOK ELECTRICAL INSTRUMENT CO.
10514 Dupont Avenue - Cleveland 8, Ohio


TUBE CADDY 820
HICKOK MODEL 820
FILAMENT VOLTS
OHMS
LEAKAGE
D.C. VOLTS
EMITTER
BASE
COLLECTOR
VOLTS OHMS
TRANSISTORS

MODEL 820

STANDARD E I A GUARANTEE

The Hickok Electrical Instrument Company warrants instruments manufactured by it to be free from defective material or factory workmanship and agrees to repair such instruments which, under normal use and service, disclose the defect to be the fault of our manufacturing. Our obligation under this warranty is limited to repairing any instrument or test equipment which proves to be defective, when returned to us within 90 days from the date of original purchase, and provided the serial number has been made known to us promptly for our records.

This warranty does not apply to any of our products which have been repaired or altered by unauthorized persons in any way so as, in our judgment, to injure their stability or reliability, or which have been subject to misuse, negligence, or accident, or which have had the serial number altered, effaced or removed. Neither does this warranty apply to any of our products which have been connected, installed, or adjusted otherwise than in accordance with the instructions furnished by us. Accessories not of our manufacture used with this product are not covered by this warranty.

This warranty is in lieu of all other warranties expressed or implied, and no representative or person is authorized to assume for us any other liability in connection with the sale of our products.

Parts will be made available for a minimum period of five years after the manufacture of this equipment has been discontinued. Parts include all materials, charts, instructions, diagrams, accessories, etc., which have been furnished in the standard model.

RETURNING EQUIPMENT FOR REPAIR

Before returning any equipment for service, under warranty or otherwise, the Factory Service Department, 10514 Dupont Avenue, Cleveland, Ohio must first be contacted giving the nature of the trouble. Instructions will then be given for either correcting the trouble or returning the equipment. Upon authorization this equipment should be forwarded directly to Supreme Electronics, Inc., Greenwood, Mississippi or to a designated service station in your locality. All correspondence pertaining to repair should be directed to Hickok Office at 10514 Dupont Avenue, or to the service station to which equipment was returned.

REGISTRATION CARD

The above guarantee is contingent upon the attached registration card being returned to the factory immediately upon receipt of the equipment.

THE HICKOK ELECTRICAL INSTRUMENT COMPANY
Cleveland, Ohio

HICKOK

INSTRUCTION BOOK
FOR
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MODEL 820

TESTING TRANSISTORS

1. Determine type of transistor -- PNP or NPN.

2. Switch Function Selector to Transistor Test Position.

3. The meter Reversing switch is set to normal.

4. Zero adjust meter.

5. Switch Filament Selector to PNP or NPN, depending on type of transistor.

6. Connect test leads to Transistor jacks. When checking power transistors use jacks Emitter, Base and Power Collector. When checking low power transistors (under 500 MA of Collector Current) use jacks marked Emitter, Base and Low Power Collector.

7. Connect test leads to proper Transistor terminals.

8. Read Transistor leakage on Transistor Leakage Scale. If in the red, the transistor has high leakage and should be replaced.

9. Set Ohms Adj. control to either the extreme clockwise position or to the extreme counterclockwise position, depending on whether the transistor is a low power type or a power type.

10. Depress transistor gain button for gain reading which is read on the Transistor Gain scale.

Transistor gains of less than 15 should be considered poor. Transistor Gains of 20 to 50 are generally average. Transistor Gains of 50 and above are considered better than average.

If the transistor readings are erratic, the transistor should be replaced. An extremely good Transistor will show low leakage and high gain.

CHECKING VOLTAGES

To use the Model 820 as a voltmeter, set Filament Selector to any position except Transistor PNP-NPN.

1. The Function Selector is switched to the desired range of the DC Volts section.

2. The two test leads are plugged into the Volts-Ohms jacks. The common jack is labeled negative.

3. The meter is zero adjusted and the Caddy Pal is ready for use as a vacuum tube voltmeter.

4. To measure negative voltages the meter reversing switch is set to the minus volts position. This eliminates the switching of leads and also prevents the danger of shock.

CHECKING RESISTANCE

Set Filament Selector to any position except Transistor PNP-NPN.

1. The Function Selector is set to the desired range of the ohms section.

2. The two test leads are plugged into the Volts Ohms jacks.

3. Set meter reversing switch to normal.

4. Zero adjust meter with test leads open circuited. Top of scale

5. Short circuit test leads and adjust Ohms Adj. controls for full meter scale deflection. min.

6. The instrument is ready for use.

CHECKING CATHODE RAY TUBES

To test television cathode ray tubes, the Hickok CRT-1 Adapter is used in conjunction with the Tube Caddy Pal. This enables the serviceman to perform the same critical checks that are made on vacuum tubes.

Set up as follows:

1. Set filament Selector to 6 volts, or whatever filament voltage is required.

2. Set meter switch to Normal.

3. Set Function Selector to any of the leakage positions or Contact Potential.

4. Zero adjust meter.

5. Plug in the male end of CRT-1 adapter into test socket #1 of the Tube Caddy Pal socket panel and the other end to the cathode ray tube.

6. Connect 2nd anode lead of the CRT-1 to anode of cathode ray tube.

7. Proceed with test. Checks made are the same as with vacuum tubes.

INTERPRETING READINGS

A Contact Potential test should be made first. This will determine whether or not the grid or cathode is open, for this is a common occurrence in cathode ray tubes. If the grid or cathode are not open a Contact Potential of approximately .75 volts will be indicated by the meter.

If the tube is shorted the pointer will read down scale on the Contact Potential test (below zero) and beyond full scale on the leakage tests.

If the tube has grid emission or is gassy then grid current will be indicated on the grid leakage test. Tubes with grid current of less than 1 μa should be considered good. Tubes with grid currents of 1 to 3 μa, fair to poor, and above 3 μa, bad.

Heater-Cathode leakages of 20 megohms or greater are considered acceptable.

MAINTENANCE

The Model 820 Tube Caddy Pal should give long uninterrupted trouble-free service. Other than an occasional tube change, no electrical repair should be required. Should the instrument become damaged and parts required, please contact one of our authorized service stations in your locality or The Hickok Electrical Instrument Company, Service Department, 10514 Dupont Avenue, Cleveland 8, Ohio

INSTRUCTION BOOK
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MODEL 820

TECHNICAL CHARACTERISTICS

Scales and Ranges:

D. C. Volts - 0-1. 5, 0-15, 0-150, 0-750

Ohms - 100 Ω Center Scale
X1, X100, X10K

Heater Cathode Leakage
1 Meg Center Scale
Readable Leakage to 50 Megohms

Grid Current
0-5 μa Full Scale (Standard)
0-1 μa Full Scale (Super Test)

Transistor Gain
DC Current Gain
0-140 Full Scale

Transistor Leakage
Scale calibrated in terms of Quality - Good, Fair and Bad

Contact Potential
0-1. 5 volts across 4. 7 megohms

Input resistance on all DC volts ranges - 10 megohms

Power Supply required - 115 VAC, 60 cycles

Power Consumption - 15 watts

EQUIPMENT SUPPLIED
(One Complete Unit)

1 Tube Caddy Pal Tester
1 Tube Chart
1 Instruction Book
2 Test Leads
1 Test Probe

INTRODUCTION

The Model 820 Tube Caddy Pal is a truly versatile Tester. It was designed primarily for the TV Technician for home service calls. Because of its small compact size the Model 820 will fit conveniently into a standard tube caddy.

This tester has many of the necessary features for trouble shooting TV sets in the home. The most common defects found in TV receivers that cause failure are shorted or open components and tubes. For troubleshooting components the Model 820 features an excellent Volt and Ohmmeter section that covers a wide range of voltages and resistances. For checking tubes, this tester features a very sensitive Gas, Grid Emission, and Grid Leakage test for IF, RF and Audio tubes.

Hum problems in series string sets, due to heater cathode leakage are solved very easily with this tester. Heater cathode leakage up to 50 megohms is read directly in ohms on an expanded meter scale.

Shorted tubes are easily found with the Model 820. Shorts from grid to screen or plate up to 100 megohms will indicate full scale deflection on the meter. Grid to cathode shorts up to 30 megohms will indicate full scale deflection on the meter.

As an added feature, the Model 820 incorporates a Transistor Test. The Transistor Test checks two parameters that determine the quality of a transistor. The two are, the current gain and the leakage current between collector and emitter with the base open circuited.

Although this tester was designed specifically for the TV Technician, it will find a good deal of application in engineering laboratories, primarily because the sensitive grid current and leakage measurements made with this instrument are read directly on a calibrated meter scale.

FUNCTION OF CONTROLS AND JACKS

Function Selector. This selector is located on the right side of panel. The function of each position of this selector is described below.

Transistor Test. With the selector in this position and the Filament selector set to Transistor PNP or NPN the tester is ready for testing transistors.

Contact Potential. In this position the tester is set up for a Contact Potential test. The 0-1.5 Volt scale indicates Contact Potential in volts directly.

Grid Leakage. Two ranges are provided for in this test; 0-1 μa and 0-5 μa. The term Grid Leakage is defined as the total grid current flow caused by gas, grid emission or resistance from the grid to any other element. The flow of current caused by these defects is in the direction such that the grid will become positive. This test is performed with the tube in a plate current cut-off condition primarily because these defects are most evident in this condition.

H-K Leakage. In this position the tester is set up to measure heater to cathode leakage of the tube under test. The H-K scale is calibrated directly in megohms.

Ohms X1, X100, X10K. In this position the tester operates as a conventional ohmmeter. Test leads are plugged into the jacks labeled Volts Ohms. The two test leads are shorted together and the zero adjust control is adjusted to the ohms set line. The tester is ready to measure resistance.

DC Volts - 1.5 - 15 - 150 - 750. In this position the test operates as a conventional VTVM. The input resistance is 10 megohms on all ranges. The leads are plugged into jacks labeled Volts Ohms. The red jack being positive and the black one negative.

Filament Selector. This selector selects the required filament voltage for the tube under test. For example, if a 6AG5 tube is being tested, filament selector is set to the 6-7 volt position.

Transistor PNP-NPN. When a transistor is being tested the filament selector is set to either PNP or NPN, depending on the type of transistor.

Press for Transistor Gain. In checking transistors this button is depressed to measure gain. The gain scale on the meter is read directly. With the button in the up position, leakage is measured and read on the leakage scale.

Zero Adjust. This control adjusts the meter zero. The meter should be zero adjusted for all test functions.

Ohm Adj. This control serves two functions. It is utilized in the ohms section for setting the meter pointer to full scale for resistance measurement and in transistor testing. In transistor testing the Ohms Adj. control is adjusted to the extreme counterclockwise position when checking power transistors or to the extreme clockwise position when checking low power transistors.

Transistor Test Jacks. These jacks are utilized for checking transis-

tors. They are labeled Emitter, Base, Low Power Collector and Power Collector. When checking Power Transistors, the Emitter, Base, and Power Collector jacks are used. When checking low power transistors, the Emitter, Base and Low Power Collector jacks are used.

Tube Test Sockets. These sockets are numbered 1 thru 11. When a tube is to be tested the proper socket is chosen by referring to the tube chart.

OPERATION

In order to insure stable operation the tester should be turned on 3 to 5 minutes prior to use. This allows sufficient warm-up time to stabilize the metering circuits.

GENERAL INFORMATION

Before getting into the testing of tubes the terms 'Grid Leakage", "H-K Leakage" and "Contact Potential" will be defined. In this way the Technician will derive more benefit from the results of tests performed with his Tube Caddy Pal.

GRID LEAKAGE

The term "Grid Leakage" is defined as a total grid current flow caused by "Gas", "Grid Emission" or "Resistance" from the grid to any other element of the tube. The flow of current caused by these defects is in the direction such that the grid will become positive. This is illustrated in Figure 2.

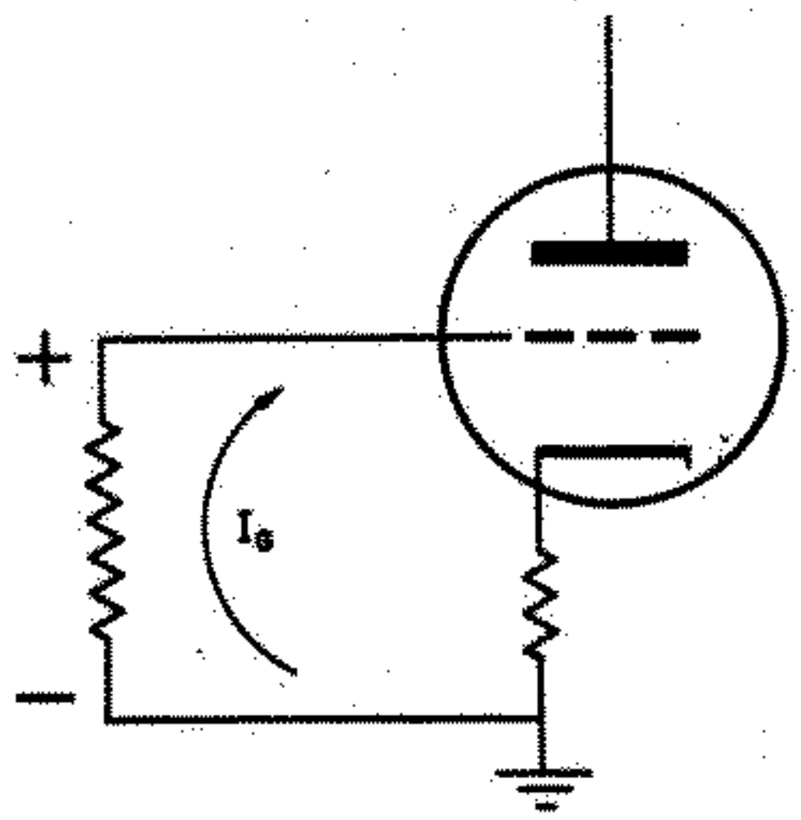


FIG. 2

The grid of the tube with these defects will become positive. The amount the grid becomes positive will depend largely on the severity of the defect and on the size of the grid resistor used in the circuit. If a tube measures 1 μa of grid current and the grid resistance used in the circuit is 1 megohm, then the grid will be 1 volt positive -

$$\frac{1 \times 10^{6}\ \Omega \text{ resistance}}{1 \times 10^{-6} \text{ amps}} = 1 \text{ volt}$$

The positive voltage subtracts from the normal operating bias voltage of the tube. Consequently the tube then draws a larger plate current than normal. This causes the tube to overheat. If the original grid current was due to gas or grid emission, the overheating will cause more grid current to flow. Thus a regenerative action sets in and in a period of time the tube will destroy itself providing there are no current limiting resistors in the plate circuit.

Tubes in the R.F. and I.F. amplifier stages in a TV receiver are particularly troublesome when they become gassy. This is due to several reasons. First, the plate circuits of these stages contain little or no resistance to limit plate current. Secondly, the grid circuit resistance is usually high--approximately 1 megohm. Thirdly, the self bias resistors used in these circuits are small and therefore the tubes rely on AGC voltage for their normal operating bias. The positive grid voltage developed by a gassy tube will cancel the AGC bias voltage. This results in amplifier overloading and clipping of the amplified signal. This causes loss of vertical and horizontal sync.

H-K LEAKAGE

H-K leakage is defined as the leakage in resistance between the heater and cathode. This leakage is read directly on the H-K scale in megohms.

This measurement is particularly important in series string TV receivers. Since some of the series string tubes are operated at high filament potentials with respect to ground, the slightest amount of heater to cathode leakage will cause 60 cycle hum to be injected into the circuit.

CONTACT POTENTIAL

Contact Potential is a voltage that is produced between the grid and cathode of a tube. It is due to a thermal electric effect between the elements of a tube. This potential can be considered as a built-in bias voltage within the tubes. Its polarity is such that the grid is negative with re-

spect to cathode. Its voltage varies over a wide range of approximately -.25 to -1.5 volts from tube to tube even though tubes may be of the same type number.

Contact Potential causes a current to flow through the grid resistor, and this is illustrated in Figure 3.

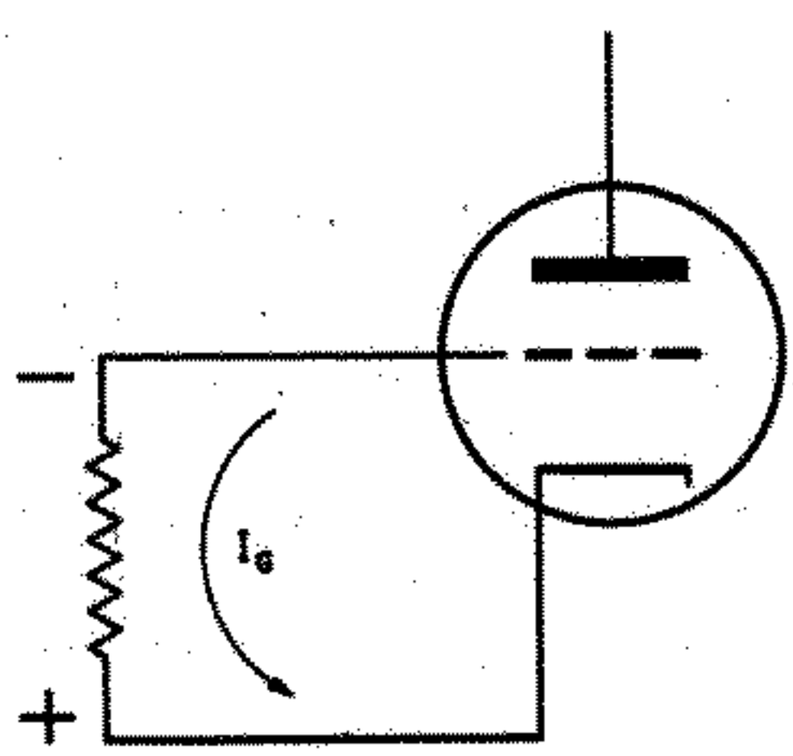


FIG. 3

The undesirable effects of Contact Potential can be cancelled by increasing the tube's bias to a value that is greater than that of the Contact Potential. However this is not always possible in all cases. In high gain preamplifiers or limiter stages that operate with little or no bias, Contact Potential will have an appreciable effect on the gain and performance of the circuit.

To get optimum results from a limiter stage in an FM or TV sound I. F. a tube with a small Contact Potential should be chosen with the Tube Caddy Pal. A tube with a Contact Potential of .75 volts or less should be used for this application.

Low noise tubes for TV tuners can be selected with the Tube Caddy Pal. A tube with a low Contact Potential will cause less current to flow through the grid resistor than a tube with a high Contact Potential. Current flow through a resistor produces noise due to thermal agitation. Tubes with minimum Contact Potential should be chosen for this application.

SHORTS

Direct shorts between elements of a tube are indicated by a full scale pointer deflection of the meter. The most sensitive position of the function selector for this test is Grid Leakage X1 μa. To distinguish between shorts and grid leakage, the meter pointer is observed as the tube is

plugged into its socket. If the pointer deflects immediately, the tube is shorted. If the pointer moves up slowly as the tube warms up then it is due to Grid Leakage.

Grid to plate or screen shorts of 100 megohms will cause the pointer to deflect full scale. Grid to cathode shorts of 30 megohms will cause a pointer deflection of full scale. Heater to Cathode shorts are checked on the H-K Leakage position of the function selector and the leakage or shorts are read directly on the H-K Leakage scale in megohms.

TESTING TUBES

1. Set Function Selector to any one of three Leakage positions.

2. The meter reversing switch is set to normal.

3. Zero adjust meter with the Zero Adjust control.

4. Set filament selector to the proper filament voltage corresponding to the first number of the tube type number. For example 12AU7, set filament selector to 12.

5. Refer to tube chart located on the back of case for the listing of proper test socket. For example, the tube under test is a 12AU7. The tube chart will list this as AU7 and give a test socket number 7.

6. Plug tube into the proper test socket.

7. <u>If meter deflects full scale immediately, the tube is shorted and should be replaced.</u>

8. Test tube for Grid and H-K leakage by merely switching the function selector to each position and noting readings.

9. When measuring Contact Potential the Function Selector is switched to Contact Potential and the 0-1.5V range is used directly.

INTERPRETING READINGS

Grid Leakage. The Model 820 Tube Caddy Pal features two ranges for the Grid Leakage Test. 0-1 μa and 0-5 μa.

The amount of grid current that is permissible depends entirely on the circuit conditions the tube is operated in.

The 0-5 μa range is used for conventional tubes where the -

1. Grid circuit resistance is low -- 100K or less.
2. A fairly large self-bias cathode resistor is used.
3. The plate load is a resistance to help limit plate current.

Under the conditions listed above, grid currents up to 3 μa are tolerable.

The 0-1 μa range which is called the super test range, is used for T.V. RF-IF amplifiers or any tube that is operated under the following conditions.

1. Large grid resistor -- 1 megohm or larger.
2. Small self bias cathode resistor.
3. Little or no resistance in the plate circuit.

Under conditions listed above grid currents of .1 μa or less are tolerable.

It should be remembered that gassy tubes show very little gas when the tube is cold or when first turned on. It is therefore recommended that the tubes to be checked be preheated or be taken hot from an operating TV receiver.

H-K LEAKAGE

Normally a tube with a heater to cathode leakage of 1 megohm or less should be replaced.

Tubes used in series string arrangements such as in series string TV receivers should be rejected at 10 megohms or less.

Tubes used in the input stages of high gain audio amplifiers should be rejected at 20 megohms or less.

CONTACT POTENTIAL

To obtain a true Contact Potential reading the tube must first be checked for Grid and H-K leakage. This is because Grid or H-K leakage produce a grid polarity that is opposite to the grid Contact Potential polarity. The grid is positive when Grid Leakage is present whereas the grid is negative due to Contact Potential. Hence they tend to cancel one another.

Therefore it must first be ascertained that the tube has little or no grid or H-K leakage.

It should be remembered that the tube with the lowest Contact Potential is the most desirable with all other characteristics being equal.

ALT	DRAWING NUMBER
	948W

TRANSISTOR TEST JACKS

EMITTER · BASE · COLLECTOR · VOLTS OHMS · GRD

LOW POWER · POWER

B+

R1 3K ZERO ADJUST

R2 OK · R33* · R3 10K

M1

S3 FILAMENT VOLTS SELECTOR

2.3V · 3.15V · 4.2V · 4.7V · 6.3V · 8.4V · 12.6V · 16.8V · 0

S1 RANGE SELECTOR SWITCH

OHMS ADJ R4 3K · R5 390 · R6 6BK · R7 2.7K · R8 1M · R9 1M · R10 4.7M · R11 270 · R12 1K · R13 1K · R14 1M · R15 6.8K · R16 1M · R17 20K · R18 .3M · R19 80K · R20 1.2M · R21 47K · R22 .9M · R23 750K · R24 1M · R25 95 · R26 15 · R27 15 · R28 9M · R29 10K · R30 33K · R31 10K · R32 47K 1W · C1 .01 µF · C2 .005 µF · C3 1000µFD 6V · C4 10µF 200V · C5 1005 µFD

V1A (1/2)12AU7 · V1B (1/2)12AU7 · S2 METER REVERSE

+3V. · -3V. · +3V. · -3V. · X1 · X2 · 1N91 · T1

NOTES

1. RESISTANCES ARE SHOWN IN K = 1,000 Ω, M = 1,000,000 Ω
2. + = CONNECTION, + = NO CONNECTION
3. S1 SHOWN IN CONTACT POTENTIAL POSITION, S3 SHOWN IN OFF POSITION

CALIBRATION RESISTOR

BROWN · WHITE · YELLOW · GREEN · RED

FIL 2 · FIL 1 · CATH · GRID · PLATE

TO TUBE SOCKET PANEL CONN.

NO.	ALTERATION	BY	APP'D	DATE

MODEL 820-TUBE CADDY PAL

SCHEMATIC WIRING DIAGRAM

DRAWN & TRACED	CHECKED	APP'D	DATE
LDD			5-11-59

DRAWING NUMBER 948W

THE HICKOK ELECTRICAL INSTRUMENT CO. CLEVELAND, OHIO

Tube	Socket	Tube	Socket	Tube	Socket	Tube	Socket	Fil. Voltage	Tube	Socket	Fil. Voltage	Tube	Socket	Fil. Voltage
BE6	2	CX7	7	EZ6	2	1216	3	6.	6186	2	6.	7851	1	6.
BE7	7	CX8	9	F6	1	1217	2	6.	6189	7	6.	9001	2	6.
BF5	4	CY5	2	FH6	1	1613	1	6.	6201	7	12.	9003	2	6.
BH6	2	DB6	2	FV6	2	1614	1	6.	6211	7	12.	2C50	11	12.
BH7	7	DC6	2	FW8	7	1621	1	6.	6216	7	6.	2C52	11	12.
BH8	9	DE6	2	G6	1	1622	1	6.	6265	2	6.	B36	11	12.
BJ5	2	DF7	7	GA8	7	1631	1	12.	6414	7	12.	B152	7	12.
BJ6	2	DG6	1	GB8	10	1632	1	12.	6485	2	6.	B329	7	12.
BK4	1	DJ8	7	GH8	8	5590	2	6.	6669	4	6.	E80CC	7	12.
BK7	7	DK6	2	GM6	2	5591	2	6.	6678	8	6.	E88CC	7	6.
BL7	1	DM5	6	GM8	7	5654	2	6.	6679	7	12.	EC92	3	6.
BL8	2	DM7	7	GN8	9	5691	11	6.	6680	7	12.	ECC33	11	6.
BM5	4	DN7	11	J5	1	5692	11	6.	6681	7	12.	ECC35	11	6.
BN7	7	DQ6	1	J6	3	5725	2	6.	6829	7	12.	ECC81	7	12.
BQ6	1	DS5	4	K6	1	5749	2	6.	6851	7	6.	ECC82	7	12.
BQ7	7	DT6	2	L5	1	5750	2	6.	6913	7	12.	ECC83	7	12.
[illegible]	7	DY7	7	L6	1	5751	7	12.	6922	7	6.	ECC85	7	6.
[illegible]	9	DT8	7	M5	10	5814	7	12.	6954	2	6.	ECC86	7	6.
[illegible]	11	DW7	7	N8	7	5844	3	6.	6955	7	12.	ECC88	7	6.
[illegible]	7	DW8	7	P5	1	5871	1	6.	6968	2	6.	ECC91	3	6.
[illegible]	2	EA5	2	R5	6	5881	1	6.	7001	2	6.	ECC189	7	6.
[illegible]	2	EA7	11	SL7	11	5915	2	6.	7025	7	12.	ECF82	8	6.
BZ7	7	EA8	8	SN7	11	5920	3	6.	7032	2	6.	EF93	2	6.
[illegible]	7	EB8	9	SU7	11	5932	1	6.	7036	2	6.	EF94	2	6.
C5	1	ED5	6	T4	5	5963	7	12.	7056	2	14.	EF95	2	6.
C8	10	EF6	1	U6	1	5964	3	6.	7057	7	14.	EFC80	8	6.
CA3	6	EG7	11	U8	8	5965	7	12.	7058	7	14.	EH90	2	6.
CD6	2	EH5	6	V6	1	6005	4	6.	7059	8	14.	EK90	2	6.
CE5	2	EH8	9	W6	1	6045	3	6.	7060	9	14.	HCC85	7	17.
CF6	2	EM7	1	X8	9	6046	1	12.	7062	7	12.	HF93	2	12.
CG6	2	EN6	1	Y6	1	6057	7	12.	7167	2	14.	HF94	2	12.
CG7	7	ES6	2	9A8	8	6060	7	12.	7236	11	6.	HK90	2	12.
CH7	7	ES8	7			6067	7	12.	7244	3	6.	KT66	1	6.
CQ8	8	EV5	2			6072	7	12.	7258	10	14.	PCF82	8	9.
CS6	2	EW6	2			6085	7	12.	7316	7	12.	WE403A	2	6.
CT8	10	EW8	7			6101	3	6.	7318	7	12.	X727	2	6.
CU5	6	EY6	1			6136	2	6.	7408	1	6.			
CU6	1	EZ5	1			6180	11	6.	7543	2	6.			